Energy detection based spectrum sensing over enriched multipath fading channels

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Abstract

Energy detection has been for long constituting the most popular sensing method in RADAR and cognitive radio systems. The present paper investigates the sensing behaviour of an energy detector over Hoyt fading channels, which have been extensively shown to provide rather accurate characterization of enriched multipath fading conditions. To this end, a simple series representation and an exact closed-form expression are firstly derived for the corresponding average probability of detection for the conventional single-channel communication scenario. These expressions are subsequently employed in deriving novel analytic results for the case of both collaborative detection and square-law selection diversity reception. The derived expressions have a relatively tractable algebraic representation which renders them convenient to handle both analytically and numerically. As a result, they can be utilized in quantifying the effect of fading in energy detection based spectrum sensing and in the determination of the trade-offs between sensing performance and energy efficiency in cognitive radio communications. Based on this, it is shown that the performance of the energy detector depends highly on the severity of fading as even slight variations of the fading conditions affect the value of the average probability of detection. It is also clearly shown that the detection performance improves substantially as the number of branches or collaborating users increase. This improvement is substantial in both moderate and severe fading conditions and can practically provide full compensation for the latter cases.

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